rises on January 13 at 8:41 p. m. and sets on January 14, at 10:23 a. m. A day will be found to drop out for rising as well as for setting whenever the time changes from p. m. to a. m., viz, when it crosses midnight.

January 13, 1906.

Rising.	Setting.	
$15^h\ 36^m$	$15^h\ 36^m$	Meridian passage, central time, by A.
$-6\ 37$	$+6\ 37$	Approximate hour angle, by B.
$8\ 59$	$22\ 13$	Approximate times.
$-\ 4$	$-\ 4$	Correction for change of declination, by B.
-14	$+14$	Correction for change of right ascension, by C.
$8\ 41$	$22\ 23$	Astronomical central [standard] times.
13^d 8:41 p. m.	14^d 10:23 a. m.	Civil central [standard] times.
$8^h\ 40^m\ 39^s$	$10^h\ 21^m\ 59^s$	Numerical computation as check.

Accuracy.—The diagrams, especially A and C, may be used to tenths of a minute, if desired. But the nearest whole minute is sufficiently accurate in practise, since often the horizon is obstructed by terrestrial objects or dimmed by smoke, or the weather is unpropitious, and most of the times of moonrise and moonset occur during the daytime or at inconvenient hours during the night, so that only such a small percentage of the computed times are actually observed that more accurate and time-consuming computation would seem to be only so much labor wasted. As three diagrams are used, and the nearest minute is taken in each one, it may happen that in each case nearly half a minute is neglected always in the same direction, and, therefore, the results may be erroneous by more than a full minute. This is certainly possible and must occur at times, but it is just as likely that these fractions of a minute may have contrary signs and annul one another.

No account need ever be taken of second differences in the times of the moon's meridian passage. For Omaha the moon always rises within two hours and a quarter of its upper transit at Greenwich, so that the errors of these diagrams A and C counteract one another. But as the time of the moon's setting occurs within two hours and a quarter of the moon's lower transit the errors of these diagrams are additive. An examination of the Ephemeris of 1894, when the moon's ascending node was near the vernal equinox and the moon, therefore, reached a declination of over 28°, showed the maximum second difference between two successive days to be 0.24 minute. For an interval as great as sixteen hours from the time of the moon's upper transit at Greenwich, only one-third of this, or 0.08, would be effective, and this amount for the maximum hour angle (eight hours) would be only about 1.2 minute. As this is a most exceptional case, it is safe to say that, in general, this method is accurate enough to give the times within a minute. This estimate was confirmed by a more rigorous numerical computation of this same example of January 13, 1906, which was selected at random, and in which the moon's right ascension and declination, the sidereal time, and other necessary quantities were used and the same result was obtained practically within a minute.

Speed.—The speed is such that I generally compute the times of both rising and setting for a whole month in less than an hour, and sometimes even in less than 45 minutes.

A POSSIBLE EXTENSION OF THE PERIOD OF WEATHER FORECASTS.

By E. B. GARRIOTT, Professor of Meteorology. Dated February 15, 1906.

Periods of excessive heat or cold, and of drought or stress of rain, are invariably associated with marked irregularities in the location and movement or in the character and intensity of the great continental and oceanic areas of high and low barometric pressure. During periods of abnormal heat or drought in any part of the Northern Hemisphere, there is an undue and stagnated accumulation of air in and about one of the great anticyclonic areas, and a corresponding deficiency in and about one of the great cyclonic areas. Periods of cold or of excessive precipitation are due either to (1) abnormally rapid changes in the greater atmospheric areas, whereby a rapid progression of the lesser areas of high and low barometer produces a succession of cold waves and rains, or to (2) a persistent abnormal distribution or development of one or more of the greater areas whereby existing conditions of cold, or of wet, are prolonged. It is also true that abnormalities of weather over some portions of the globe, or of the Northern Hemisphere, are counterbalanced by opposite tendencies over other portions. Thus months that are exceptionally warm or cold, wet or dry, over the United States east of the Rocky Mountains have similar characteristics over Europe and at least a part of western Asia, and exhibit opposite tendencies over the United States west of the Rocky Mountains and over southeastern Asia. An explanation of this fact is found in a study of the greater areas of high and low barometric pressure or "centers of action" of the Northern Hemisphere.

These "centers of action" appear to control the character and movements of the areas of high and low barometer that appear on our daily weather maps, and in efforts to coordinate the causes that contribute to produce weather effects in the hemisphere as a whole or in any of its parts, all causes are important and none can be neglected. Professor Hann has found that pressure changes in the Azores high area and the Iceland low area are interrelated and of an opposite character, and that these changes are associated with certain phases of weather in central and northwestern Europe. He has discovered that rising barometer over the Azores is usually attended by falling barometer over Iceland, and, *vice versa*, that falling barometer in the Azores high area is attended by rising barometer in the Iceland low area. Also that falling barometer in the Iceland area produces warmer weather over central and northwestern Europe, and that rising barometer over Iceland is followed by falling temperature over northwestern Europe. It appears, therefore, that marked changes in the Azores high area, regarding which advices are cabled daily, afford an index of the character of the weather that will prevail for several days over a considerable portion of Europe.

A merely preliminary and general consideration of the whole problem places the dominating centers of atmospheric action of the Northern Hemisphere over Siberia and Bering Sea, and an examination of these areas presents an interrelation similar to that noted for the north Atlantic high and low areas. It has been observed, furthermore, that the effects of changes in the Asiatic high and the Bering Sea low are vastly greater and more widespread than those that may be associated with the north Atlantic areas, and that when pressure abnormalities within and about the Asiatic-Bering centers of action are marked, persistent and well-defined types of abnormal weather are experienced throughout the circuit of the Northern Hemisphere.

Among well-remembered abnormal seasons, or parts of seasons, when the influence of the dominating "centers of atmospheric action" was conspicuous, were the mild months of the winters of 1889–90 and 1905–6, and the cold months of the winters of 1903–4 and 1904–5. The months of the winters of 1889–90 and 1905–6 that were warm over great portions of the United States and Europe showed an unusual depression in the Bering Sea low area. The deepened Bering Sea area extended and overlapped the northwestern part of North America, and offshoots therefrom moved eastward in abnormally high latitudes. The resultant abnormal depression of the barometer over northwestern British America caused an unusual prevalence of southerly winds over northern portions of the United States and apparently prevented the formation of the areas of high barometer over British America that are essential to the origin and propagation of American cold waves.

It has also been evident that during periods of abnormal depression in the Bering Sea low area, the Pacific area of high barometer increases in mass and overlaps the southwestern coasts of the United States, producing over a greater or less portion of the region lying west of the Rocky Mountains temperatures below the seasonal average. The warmer weather over central and northwestern Europe that is usually associated with excesses in winter temperature in North America, appears to be in a great measure due to an increase in the magnitude of the Asiatic high area that attends an abnormal depression in the Bering Sea low area. At such times an unusually steep barometric gradient from Asia over Europe, and an increase in the Atlantic high area, cause an undue prevalence of warm southerly winds over central and northwestern Europe, and, coincidently, the augmented Siberian high area causes a sweep of cold north or northwest winds over southeastern Asia.

During the cold months of 1903–4 and 1904–5 an entirely dissimilar distribution of pressure in the great "centers of action" obtained. Pressure was unusually high in the Bering Sea and Iceland low areas, and the magnitude, or extent, of the Asiatic high area was vastly less than during the winters of 1889–90 and 1905–6. The Pacific high area did not impinge on the California coast, and the Azores high area was inconspicuous and unpermanent. The northwestern portion of the American Continent was not subjected to the influence of abnormally low pressure off its western coast and British America therefore became the seat of an area of high barometer from which cold waves were drawn southward in the wake of areas of low barometer that traversed the United States. The absence of the Pacific high area seemed also to contribute to a more southern origin of American storms, and to undue barometric depression and precipitation over the southwestern portion of the country. In Europe, where the winters of 1903–4 and 1904–5 were also cold we look first for the Iceland low area, and find instead pressure much above the normal in that region; the Azores high does not exist in a permanent form. The Asiatic high occupies about one-half the area that marks its limits during the warm seasons in Europe and America. The effect of this abnormal distribution of pressure over Asia and Europe is to cause an unusual prevalence of northwest winds over a greater part of Europe, and to lessen the force of winds blowing from the interior of Asia over the southeastern portions of that Continent.

The above general presentation of a few facts regarding the influence on climate and weather of the dominating "centers of atmospheric action" of the Northern Hemisphere opens or reopens the problem of so-called long-range weather forecasts. Admitting the competency of the evidence submitted regarding the influence upon general weather conditions of abnormal phases of the great centers of high and low barometric pressure, the conclusion follows that a knowledge of the development of these phases would permit legitimate calculations of the results of which they are known to be the associated contributory causes. That changes in the greater areas are consummated with extreme deliberation is a recognized fact. The fact is also presented that these changes can to some extent be followed day by day with present telegraphic facilities. Cablegrams are now available from the seat of the Siberian winter high area and from the Azores region. They will in the near future be available from Iceland and the Alaskan coast, and it will be feasible to transmit them by wireless messages, either from islands of the Aleutian chain, or from vessels taking the Great Circle route across the Pacific. With this information daily available forecasts can undoubtedly be made of the general character of the weather for at least one week in advance. Such general forecasts could specify the character, whether warm or cold, wet or dry, of the weather of the near future, and could indicate the duration and termination, days in advance, of periods of abnormal weather.

Summarized in a general way, the indications afforded for the United States would be about as follows:

Barometer rising and above the normal in the Asiatic high area and falling and below the normal in the Bering Sea low area, and, incidentally, rising over the Azores and falling over Iceland, indicate a period of mild weather over northern and eastern districts of the country.

Barometer falling and below the normal in Asia and rising and above the normal over Bering Sea, and, incidentally, falling over the Azores and rising over Iceland, indicate a period of cold weather over the country generally east of the Rocky Mountains.

The above are but two indications of the many that are afforded by a study of the great "centers of action." Others equally applicable are available for all of the seasons and possess an equal degree of merit.

The main "center of action" in the winter season is the Asiatic area of high pressure, and the character and movements of this great mass appear to control in a measure not only the interrelated actions of the lesser "centers of action," but also periods of weather that persist for days, and the character and movements of areas of high and low barometer that cause the daily changes shown on our weather maps. Furthermore it is believed that a study of the Asiatic high, and the employment of telegraphic reports from the region it occupies, will permit accurate forecasts of the monsoons in southern and southeastern Asia.

FORECASTS AND VERIFICATIONS IN WESTERN AUSTRALIA.

By W. ERNEST COOKE, Government Astronomer. Dated Perth, W. A., January 8, 1906.

From the commencement of 1905 I have adopted a new method in connection with the issue of weather forecasts, and the following statement will probably interest some of your readers.

All those whose duty it is to issue regular daily forecasts know that there are times when they feel very confident and other times when they are doubtful as to the coming weather. It seems to me that the condition of confidence or otherwise forms a very important part of the prediction, and ought to find expression. It is not fair to the forecaster that equal weight should be assigned to all his predictions and the usual method tends to retard that public confidence which all practical meteorologists desire to foster. It is more scientific and honest to be allowed occasionally to say "I feel very doubtful about the weather for to-morrow, but to the best of my belief it will be so-and-so;" and it must be satisfactory to the official and useful to the public if one is allowed occasionally to say "It is practically certain that the weather will be so-and-so to-morrow."

With a view of expressing various states of doubt or certainty, as simply as possible, I now assign weights to each item of the forecast. The signification of the weights was stated as follows, with their first issue:

5. We may rely upon this with almost absolute certainty.

4. We may rely upon this with tolerable certainty, but may be wrong about once in ten times.

3. Very doubtful. More likely right than wrong, but probably wrong about four times out of ten.

2. Just possible, but not likely. If showers are indicated, for example, they will not be heavy even if they occur at all.

1. The barest possibility. Not at all likely.

In order to familiarize the public with the new departure a number of these explanatory slips were printed and attached to the forecasts wherever they were publicly exhibited. Thus a forecast might read as follows:

Southwest district (Geraldton to Esperance.) Fine weather throughout (5) except in the extreme southwest where a few light coastal showers are possible (2). Warm or sultry for the